In re Patent No. 6,263,307 New claims

Please add the following broadening new claims 4-13:

4. A method of noise suppression filtering for a sequence of frames of noisy speech, comprising

(a) estimating the noise power spectrum, $P_{noise}(\omega)$, of a frame of noisy speech where the variable $\omega$ is the discrete frequency;

(b) computing the noisy speech power spectrum, $P_{noisyspeech}(\omega)$, for said frame of noisy speech;

(c) smoothing $P_{noisyspeech}(\omega)$ with respect to the variable $\omega$ to yield a smoothed noisy speech power spectrum, $P_{smoothednoisyspeech}(\omega)$, for said frame of noisy speech;

(d) defining a noise-suppression filter, $H(\omega)$, using $P_{noise}(\omega)$ and $P_{smoothednoisyspeech}(\omega)$;

(e) filtering said frame of noisy speech with said noise-suppression filter $H(w)$; and

(f) repeating steps (a)-(e) for a plurality of frames of noisy speech.

5. The method of claim 4, wherein:

(a) said smoothing of step (c) of claim 4 is convolution with respect to the variable $\omega$ of $P_{noisyspeech}(\omega)$ and a window function, $W(\omega)$.

6. The method of claim 4, wherein:

(a) said $H(\omega)$ includes a term $(1 - cP_{noise}(\omega)/P_{smoothednoisyspeech}(\omega))$ where c is a positive constant.

7. The method of claim 6, wherein:

(a) $c = 1$.

8. The method of claim 6, wherein:

(a) $c = 4$.

9. The method of claim 6, wherein:

(a) said $H(\omega)$ includes a term $\max\{ M^2, (1 - cP_{noise}(\omega)/P_{smoothednoisyspeech}(\omega))\}$ where M is a positive constant.

10. The method of claim 4, wherein:

(a) said estimating $P_{noise}(\omega)$ of step (a) of claim 4 uses $P_{smoothednoisyspeech}(\omega)$ and a noise power spectrum estimate, $P'_{noise}(\omega)$, of a second frame of noisy speech where said second frame is prior to said frame, as:

- when $P_{smoothednoisyspeech}(\omega) < c_1P'_{noise}(\omega)$, take $P_{noise}(\omega) = c_1P'_{noise}(\omega)$;
- when $c_1P'_{noise}(\omega) \leq P_{smoothednoisyspeech}(\omega) \leq c_2P'_{noise}(\omega)$, take $P_{noise}(\omega) = P_{smomthednoisyspeech}(\omega)$; and
- when $c_2P'_{noise}(\omega) < P_{smoothednoisyspeech}(\omega)$, take $P_{noise}(\omega) = c_2P'_{noise}(\omega)$;

where the positive constants $c_1$ and $c_2$ satisfy the condition $c_1c_2 < 1$.

11. The method of claim 10, wherein:
(a) $c_1 = 0.978$; and
(b) $c_2 = 1.006$.

12. A method of noise suppression filtering for a sequence of frames of noisy speech, comprising
(a) computing the noisy speech power spectrum, $P_{noisyspeech}(\omega)$, for a frame of noisy speech where the variable $\omega$ is the discrete frequency;
(b) smoothing $P_{noisyspeech}(\omega)$ with respect to the variable $\omega$ to yield a smoothed noisy speech power spectrum, $P_{smoothednoisyspeech}(\omega)$, for said frame of noisy speech;
(c) estimating the noise power spectrum, $P_{noise}(\omega)$, of said frame of noisy speech as:
- when $P_{smoothednoisyspeech}(\omega) < c_1 P'_{noise}(\omega)$ take $P_{noise}(\omega) = c_1 P'_{noise}(\omega)$;
- when $c_1 P'_{noise}(\omega) \leq P_{smoothednoisyspeech}(\omega) \leq c_2 P'_{noise}(\omega)$ take $P_{noise}(\omega) = P_{smomthednoisyspeech}(\omega)$; and
- when $c_2 P'_{noise}(\omega) < P_{smoothednoisyspeech}(\omega)$ take $P_{noise}(\omega) = c_2 P'_{noise}(\omega)$;

where $P'_{noise}(\omega)$ is the noise power estimate of a second frame prior to said frame and the positive constants $c_1$ and $c_2$ satisfy the condition $c_1 c_2 < 1$;
(d) defining a noise-suppression filter, $H(\omega)$, using $P_{noise}(\omega)$;
(e) filtering said frame of noisy speech with said noise-suppression filter $H(\omega)$; and
(f) repeating steps (a)-(e) for a plurality of frames of noisy speech;

13. The method of claim 12, wherein:
(a) $c_1 = 0.978$; and
(b) $c_2 = 1.006$.